APPENDIX H

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CHEMICAL ANALYTICAL PROGRAM

This appendix summarizes the field and laboratory QA/QC procedures and GeoDesign's analytical data review.

FIELD QA PLAN

The field quality assurance for this project consisted of:

- Collection and analysis of field duplicate samples
- Maintenance of chain-of-custody

Equipment rinsate blanks were not collected during this project, because over 98 percent of the soil and groundwater samples were collected using new disposable Nitrile gloves, sample plungers (for collection of soil samples via 5035 Method), and tubing without the use of sampling equipment that required decontamination.

FIELD DUPLICATES

Field duplicates consist of two samples collected sequentially from one sample location to assess data variability. The field duplicates (identified with the prefix Duplicate or DUP) were collected at a frequency of approximately 5 percent of the total number of samples submitted for analysis and analyzed by the same analytical methods used for other soil samples. The analytical results are presented in Tables 2 through 57 and will be submitted in electronic format in accordance with WAC 173-340-840(5).

CHAIN OF CUSTODY

Chain-of-custody procedures were followed during handling and transport of the soil samples to the analytical laboratory. The laboratory held the samples in cold storage pending extraction and/or analysis. The analytical results, analytical methods reference, and laboratory quality control records are included in this appendix. The analytical results are presented in Tables 2 through 57 of this report and will be submitted in electronic format in accordance with WAC 173-340-840(5)

LABORATORY QA PLAN

The analytical laboratory maintains an internal quality assurance program, consisting of a combination of the following:

- **Blanks** – Blanks are laboratory-prepared soil or water samples that are free of contaminants. The blanks are carried through the analysis procedure along with the field samples, to document that contaminants were not introduced to the samples during sample handling and analysis.

- **Surrogate Recoveries** – Surrogates are organic compounds that are similar in nature to the analytes of concern, but are not usually naturally occurring. The surrogates are added to QC and field samples prior to analysis. The percent recovery of the surrogate is calculated to demonstrate acceptable method performance.
- **Duplicates** – Duplicates are obtained by splitting a sample into two parts. The two separate parts are carried through the analyses. The analytical results are then compared by calculating the relative percent difference between the samples.
- **Matrix Spike and Matrix Spike Duplicate Recoveries** – A matrix spike sample is a sample that has been split into a second portion. The matrix spike duplicate is obtained by further splitting the matrix spike sample. A known concentration of the analyte of interest is added to the matrix spike and matrix spike duplicate samples. The analytical results for both samples are then compared for relative percent difference and percent recovery to demonstrate acceptable method performance.
- **Blank Spike/Blank Spike Duplicate Recoveries** – Blank spike and blank spike duplicate samples are obtained and analyzed in the same procedure as the matrix spike/matrix spike duplicate samples. However, the laboratory blank sample is used to obtain the blank spike/blank spike duplicate samples. The percent recovery and relative percent difference of the known concentration of analyte of interest added to the blank spike/blank spike duplicate sample are calculated after chemical analyses to demonstrate acceptable method performance.

SUMMARY OF ANALYTICAL DATA REVIEW

GeoDesign reviewed the analytical data reports for data quality exceptions and deviations from acceptable method performance criteria. Common problems included surrogate, matrix spike/matrix spike duplicate recoveries, and relative percent differences outside of stabilized control limits. Recovery or reproducibility problems were confirmed to be the result of matrix interference, and acceptable method performance was demonstrated through other QC data. It is our opinion that the quality of the chemical analytical data used to form conclusions in this report is acceptable, based on our review of the results and associated QC parameters..

Nonconformances noted during the data quality review are presented on the following table:

TABLE H-1
QA/QC Summary
The Village at Evergreen
Vancouver, Washington

Flag	Sample I.D.(s)	Analyses	Description
A-01	8040218-DUP1, 8050124-MS2, 8030174-MS1, CAA-2-1ox(4.5-5.0), CAA-2-14 (4-4.5)[1], CAA-2-15 (4-4.5), CAA-2-24(10.5-11.0)[1], CAA-2-25(10.0-10.5)[1], CAA-2-26(12.5-13.0)[1], CAA-2-27(12.5-13.0), CAA-2-28(4.5-5.0), CAA-2-29(5.5-6.0)[1]	5035/NWTPH-Gx, EPA 8270C (SIM), EPA 7471A, and/or EPA 8081B	Internal standard areas below acceptable limits (50-200%) due to system degradation. Results for these analytes may be biased low. However, with the exception of those samples that were disposed of at Hillsboro Landfill, the affected analytes were not detected in source samples.
A-01a, -01b, -01c, -01d, & -01g	CAA-2-1ox(4.5-5.0), CAA-2-2(3.0-3.5)[1], CAA-2-3(3.0-3.5), CAA-2-5(1.5-2.0), CAA-2-8(2.5-3.0)[1], CAA-2-10(1.5-2.0)[1], CAA-2-19(8.5-9.0)[1], CAA-2-23(11.0-11.5)[1], CAA-2-24(10.5-11.0)[1], CAA-2-25(10.0-10.5)[1], CAA-2-26(12.5-13.0)[1], CAA-2-27(12.5-13.0), CAA-2-28(4.5-5.0), CAA-2-29(5.5-6.0)[1], Dup-10, Dup-11[1]	EPA 8081B	Due to sample matrix effect, ending Continuing Calibration Verification (CCV) fails low between 57 and 77 percent (acceptable range is 80-120). Data may be biased low. However, detected analytes were significantly below the corresponding MTCA screening criteria. Therefore, the data is acceptable for its intended use.
A-01e	8050101-DUP1	EPA 8270C (SIM)	Estimated Results. Related Internal Standard recovery outside of acceptable 50 to 200 percent limits. All affected analytes were not detected in source sample. Therefore, data quality is not affected.
A-01f	8050124-MS2	EPA 8270C (SIM)	Internal Standard areas for four analytes, (benzo(a)pyrene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene) were below acceptable limits (50-200%) due to system degradation. However, percent recoveries for benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were within control limits. Results for benzo(g,h,i)perylene may be biased low. However, MTCA screening criteria is not established for this analyte. Data quality is acceptable for the intended use.
A-02	8030263-BS1, CAA-2-14 (4-4.5), CAA-2-15 (4-4.5)	EPA 8270C (SIM) and/or EPA 8081B	LCS recovery is slightly above control limits, sample results may be biased high. Additionally, the detected analyte was below MTCA screening criteria. Data quality is acceptable for the intended use.
A-03 & -03a	8030263-MS	EPA 8270C (SIM)	Peak Separation between Benzo(b) and Benzo(k)Fluoranthenes does not meet method specified requirements. Recoveries for Matrix Spike are estimated below control limits. Data may be biased low because of matrix interference and/or poor recovery. However, with the exception of sample Drywell-5(16.5-17), in which PAHs were not detected, all soil samples associated with this Matrix Spike were disposed of at Hillsboro Landfill. Therefore, data quality is acceptable for the intended use.
E	CAA-2-19(8.5-9.0)[1]	EPA 8260B	GTL (EPA) - Greater than upper calibration limit: Actual sample concentration is known to be greater than the instrument's upper calibration range. Soil represented by this sample was disposed of at Hillsboro Landfill.
EST	8050124-MS2	EPA 8270C (SIM)	Result reported is estimated within control limits. Data quality is acceptable for the intended use.
F-03	8030312-DUP1, 8040105-DUP1, 8050030-DUP1, CAA-2-24(10.5-11.0)[1]	NWTPH-Dx	The result for the oil-range hydrocarbon is elevated due to the presence of individual analyte peaks in the oil quantitation range that are not representative of the fuel pattern reported. With the exception of CAA-2-24(10.5-11.0), which was disposed of at Hillsboro Landfill, oil-range hydrocarbons were not detected in the flagged data. Data quality is acceptable for the intended use.
F-05	8040003-DUP2, 8050030-DUP1, 8040179-DUP1, AST-3ox (0.75-1)[1], CAA-2-24ox (10.5-11.0)[1]	NWTPH-HCID and/or NWTPH-Dx	The sample chromatographic pattern for these samples do not resemble the fuel standard used for quantitation. With the exception of AST-3ox(0.75-1.0), which was disposed of at Hillsboro Landfill, diesel- and/or oil-range hydrocarbons were not detected in the flagged data. Data quality is acceptable for the intended use.
F-06	8040267-DUP1	NWTPH-HCID	Results in the diesel organics range are primarily due to overlap from a gasoline range product. Thus, results are biased high. In addition, diesel-range hydrocarbons were estimated at a concentration that is below MTCA screening criteria. Data quality is accepable for the intended use.

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Flag	Sample I.D.(s)	Analyses	Description
F-07	8040073-DUP1, 8040121-DUP1, 8040314-DUP1, AST-3-5(1.5-2.0)[1]	NWTPH-HCID and/or NWTPH-Dx	Results in the diesel organics range are primarily due to overlap from a heavy oil range product. Thus, results are biased high. In addition, diesel-range hydrocarbons were reported at a concentration that is below MTCA screening criteria. Data quality is acceptable for the intended use.
F-08	8040297-DUP2	NWTPH-Dx	The heavy oil range organics present are due to hydrocarbons eluting primarily in the diesel range. Thus, results are biased high. In addition, diesel-range hydrocarbons were reported at a concentration that is below MTCA screening criteria. Data qualtiy is acceptable for the intended use.
F-09	8040121-DUP1	NWTPH-HCID	Results in the Gasoline Range are primarily due to overlap from a heavier fuel hydrocarbon product. Thus, results are biased high. In addition, gasoline-range hydrocarbons were reported at a concentration that is below MTCA screening criteria. Therefore data qualtiy is acceptable for the intended use.
J2	Piping-4(2.0-2.5)[1]	8270C	Surrogate recovery limits are below established lower control limits. Data are biased low. However, soil represented by this sample was disposed of at Hillsboro Landfill. Based on acceptable surrogate recoveries for other samples and for the laboratory quality control samples, this exception is not considered significant. Data quality is acceptable for the intended use.
J3	CAA-2-1 (30.-3.5)[1], CAA-2-2 (3.-3.5)[1], CAA-2-3(3.0-3.5), CAA-2-4(2.5-3.0), CAA-2-5(1.5-2.0), CAA-2-6(2.0-2.5), CAA-2-7(2.0-2.5)[1], CAA-2-8(2.5-3.0)[1], CAA-2-10(1.5-2.0)[1], CAA-2-14(4.0-4.5), CAA-2-15(4.0-4.5), CAA-2-18(8.0-8.5), CAA-2-19ox(8.5-9.0)[1], CAA-2-23ox(11.0-11.5), CAA-2-24ox(10.5-11.0), CAA-2-26ox(14.0-15.0), CAA-3-1(15.5-16.0), CAA-3-2(16.0-16.5), CAA-3-3(15.5-16.0), CAA-3-4(15.5-16.0), CAA-3-5(16.0-16.5), CAA-3-6(16.0-16.5), CAA-3-7(16.5-17.0), CAA-3-8(15.5-16.0), CAA-3-9(16.0-16.5), CAA-3-10(16.0-16.5), CAA-3-11(15.5-16.0), CAA-3-12(15.5-16.0), CAA-3-14(10.5-11.0), CAA-3-15(11.0-11.5), CAA-3-16(14.0-14.5), CAA-7-3(3.0-3.5)[1], CAA-7-3ox(3.0-3.5), CAA-7-4(2.0-2.5), CAA-7-5 (2.5-3.0), CAA-7-6(1.5-2.0), Drainline-1[1], Drainline-1 (0.5-1.0), Drywell-3(14.5-15.0)[1], Drywell-3(16.5-17), Drywellseds-8[1], Drywell-5(16.5-17), Drywell-6 (19.5-20)[1], Drywell-8(8.0-8.5), DrywellSeds-5[1], DrywellSeds-6[1], Duplicate-1, DUP-3, DUP-8, FrenchDrain-1(7-7.5), Piping-1(3), Piping-2(3), Piping-3(3), Piping-4(2.0-2.5), Piping-7(3.5-4.0), Piping-8(3.5-4)[1], Piping-9(3.5-4.0), Piping-10(3.5-4.0), Piping-11(4.0-4.5)[1], Piping-12(3.5-4.0)[1], Piping-13(4.5-5.0),	8270C and/or 8260B	The associated batch QC was outside the established quality control range for precision due to non-homogeneous sample matrix. However, the relative percent difference for the laboratory's matrix spike and the matrix spike duplicate recoveries are within established control limits. Additionally, the batch was accepted based LCS/LCSD recoveries, which are within laboratory established cotrol limits that are comparable with industry standard. Therefore, data quality is not adversely affected and is acceptable for the indended use.
J4	CAA-2-1 (30.-3.5)[1], CAA-2-19ox(8.5-9.0), CAA-2-20(8.0-8.5), CAA-2-23ox(11.0-11.5), CAA-2-25ox(10.0-10.5), CAA-2-26ox(14.0-15.0), CAA-6-1(6.0), CAA-6-2(5.0-6.0), CAA-6-3(5.0-6.0), CAA-6-4(5.0-6.0), CAA-6-5(5.0-6.0), CAA-7-1(3.4-4.0), CAA-7-2(3.5-4.0), Drywell-3(14.5-15.0)[1], Drywell-2(10.0-10.5), Drywell-1(13.0-13.5), Duplicate-1, Piping-1(3), Piping-2(3), Piping-3(3), Piping-4ox(3.5-4.0), Piping-14 (0.5-0.75)[1], Piping-14ox(1.5-2.0), Piping-15(1.5-2.0), Piping-16(1.5-2.0), Piping-17(0.5-1.0)[1], Piping-17ox(2.0-2.5), Piping-18ox(4.0-4.5), Septic-2(7.5), Stockpile-1[1], Stockpile-2[1], Stockpile-3[1], Stockpile-10, Stockpile-25	8270C and/or 8260B	The associated batch QC was outside the established quality control range for accuracy due to non-homogenous sample matrix. However, the batch was accepted based on LCS recoveries, which are within laboratory established cotrol limits that are comparable with industry standard. Therefore, data quality is not adversely affected and is acceptable for the indended use.
J5	CAA-2-10(1.5-2.0)[1]	EPA 8270C (SIM)	The sample matrix interfered with the ability to make any accurate determination. Data may be biased high due to a high spike value. Additionally, soil represented by this sample was disposed of at Hillsboro Landfill. Therefore data quality is acceptable for the intended use.
J6	PIPING-3(3), PIPING-4(2.0-2.5)[1], CAA-2-10(1.5-2.0)[1]	3060A/7196A, EPA 8270C (SIM) and/or EPA 8260B	The sample matrix interfered with the ability to make any accurate determination; spike value is low. However, soil represented by the soil samples, Piping-4(2.0-2.5) and CAA-2-10(1.5-2.0) was disposed of at Hillsboro Landfill. In addition, although the concentration of hexavalent chromium could not be established in Piping-3(3), total chromium was quantitatively detected below MTCA screening criteria. Data quality is acceptable for the intended use.

TABLE H-1
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Flag	Sample I.D.(s)	Analyses	Description
J7	STOCKPILE-10	EPA 8270C (SIM)	Surrogate recovery limits cannot be evaluated; surrogates were diluted out. However, VOCs were not detected in any nearby stockpile soil samples. Data quality is acceptable for the intended use.
M-02	8040139-DUP2	EPA 8270C (SIM)	Due to matrix interference, this analyte cannot be accurately quantified. Data may be biased high as the reported result is estimated above established control limits. Acceptable method performance was demonstrated through remaining quality control data. Data quality is acceptable for the intended use.
O	PIPING-1(3), PIPING-2(3), PIPING-3(3), Stockpile-2[1], Stockpile-10	EPA 8270C (SIM)	These samples were diluted due to matrix interferences that impaired the ability to make an accurate analytical determination. The detection limits were elevated in order to reflect the necessary dilution. Data quality is unaffected.
Q-01, -04, & -(	8030198-MS1, 8030210-MS1, 8040186-MS2, 8040242-MS1, 8030172-DUP2, 8030174-DUP1, 8030174-MS1, 8030198-MS2, 8030212-DUP1, 8030292-DUP, 8030297-DUP1, 8030297-MS1, 8030297-MS2, 8030310-MS1, 8040092-DUP1, 8040127-MS1, 8040127-MS2, 8040152-DUP2, 8040157-DUP1, 8040157-MS1, 8040179-DUP1, 8040287-DUP1, 8040287-MS2, 8030312-DUP2, 8030292-DUP1, 8040003-DUP1, 8040080-DUP2, 8040105-DUP1, 8040186-DUP1, 8040196-DUP1, 8040316-DUP2, 8040316-DUP3, 8040333-DUP1, 8050030-DUP2	EPA 6020, EPA 7471A, 5035/8260B, NWTPH-HCID, NWTPH-Dx, and/or EPA 8270C (SIM)	The percent recovery and/or RPD was outside the established quality control range for accuracy due to non-homogenous sample matrix. However, the batch was accepted based LCS recoveries, which are within laboratory established cotrol limits that are comparable with industry standard. Therefore, data quality is not adversely affected and is acceptable for the intended use.
Q-08	8030263-BS1, 8030292-BS1, 8030293-BS1, 8030292-DUP1	EPA 8270C (SIM)	Recovery of Lab Control Spike or Matrix Spike was above established control limits for this analyte. Analyte was not detected, therefore data quality is not affected.
Q-11 & -18	8030198-MS1, 8030277-MS1, 8040157-MS2, 8040196-MS1, 8040138-BS1	EPA 6020 or EPA 8270C (SIM)	The spike recovery for this matrix or batch spike cannot be accurately quantified due to sample dilution required from high analyte concentration and/or matrix interference. Data are likely biased high as the matrix or batch spike exceeded control limits. Therefore, data quality is acceptable for the intended use.
Q-16	8030263-MS2	EPA 8270C (SIM)	Reanalysis of an original Batch QC sample. Data quality is acceptable for the intended use.
Q-23	CAA-2-29ox (5.5-6.0)[1]	EPA 8081B	Recovery of Continuing Calibration Verification (CCV) sample above upper control limit for this analyte. Data is likely biased high. Soil represented by this sample was disposed of at Hillsboro Landfill.
Q-25	CAA-2-2(3.0-3.5)[1], CAA-2-3(3.0-3.5), CAA-2-5(1.5-2.0), CAA-2-7ox(2.0-2.5), CAA-2-8(2.5-3.0)[1], CAA-2-10(1.5-2.0)[1], CAA-2-19(8.5-9.0)[1], CAA-2-23(11.0-11.5)[1], CAA-2-24(10.5-11.0)[1], CAA-2-25(10.0-10.5)[1]	EPA 8081B	Recovery of Continuing Calibration Verification standard was above acceptable limits. Analyte was not detected in reported client samples, therefore Data Quality is not affected.
Q-26	8030292-DUP1, 8030161-DUP1, Drainline-1[1], Piping-11(4.0-4.5)[1], Piping-17(0.5-1.0)[1], Piping-18(3.0-3.5), Dup-8	EPA 8270C (SIM)	Peak separation for Benzo(b) and Benzo(k)fluoranthenes does not meet method specified criteria. Reported result includes the combined area of the two isomers and should be considered the total of Benzo(b+k)Fluoranthenes. However, neither analytes were detected, therefore data quality is not affected.
R-02	CAA-2-22(10.5-11.0), CAA-2-23(11.0-11.5), CAA-2-26(12.5-13.0), Dup-11	EPA 8081B	The Reporting Limit for this analyte has been raised to account for interference from coeluting organic compounds present in the sample. Data quality is acceptable for the intended use.
T1	Piping-18(3.0-3.5)[1], Piping-19(3.0-3.5)[1], Piping-20(3.0-3.5)[1], Piping-21(2.0-2.5), CAA-2-10ox(1.5-2.0)	EPA 8260B, 2540G, or 8270C	Sample(s) received at greater than 4 degrees C. The soil sample CAA-2-10ox(2.0-2.5) was analyzed for SVOCs, which are known for their relatively resiliant chemical properties. Also, VOCs were field preserved and extracted from the soil sample prior to being shipped and received at a temperature greater than 4 degrees C. In addition, soil represented by remaining samples were disposed of at Hillsboro Landfill. Therefore data quality is acceptable for the intended use.
V3	CAA-8-1-4(3.0-3.5)[1], Drainline-1[1], Stockpile-5[1]	EPA 8270C	The internal standard exhibited poor recovery due to sample matrix interference. The analytical results may be biased high. Soil represented by these samples were disposed of at Hillsboro Landfill. Data quality is acceptable for the intended use.

Notes:
1. Soil represented by this sample was disposed at the Hillsboro Landfill.